

SYSTEM OVERVIEW

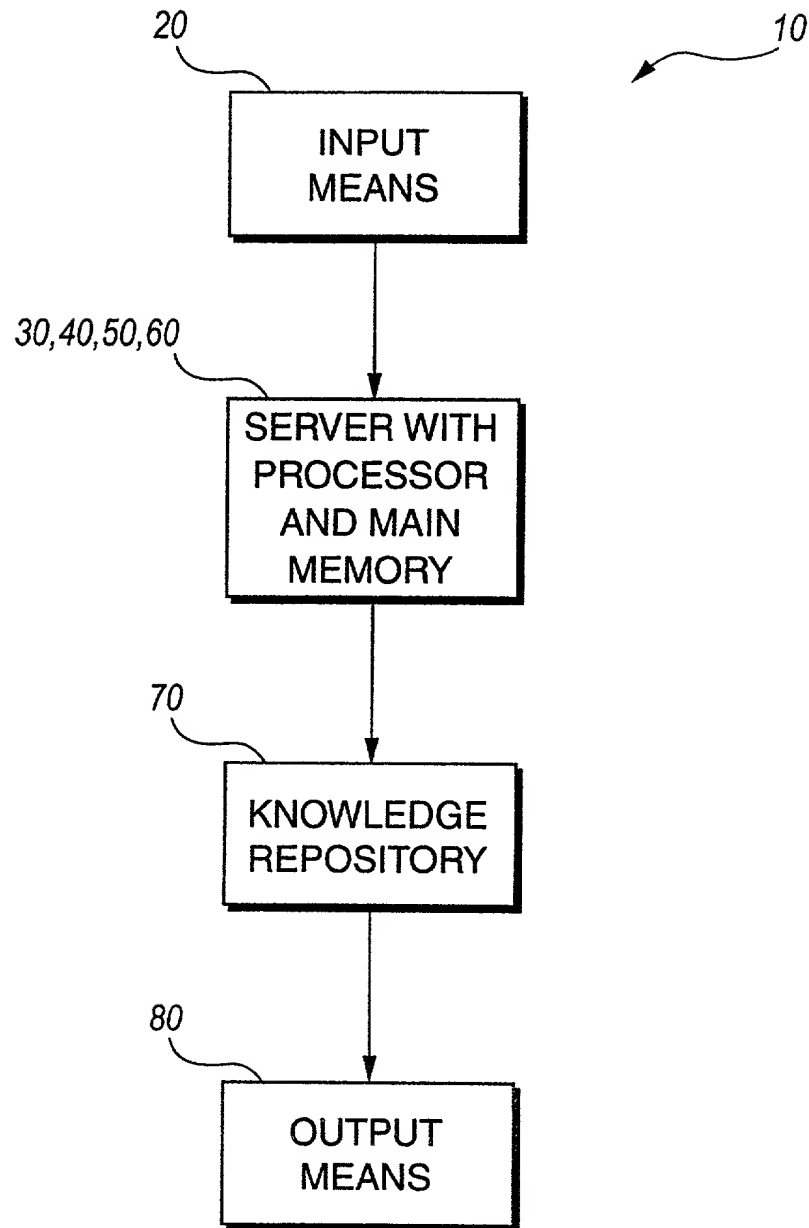


Fig. 1

OVERALL METHOD

100

- LEXICAL ANALYSIS 110
- STRUCTURAL ANALYSIS 120
- DATA MANAGEMENT 130
- RESPONSE GENERATION 140

Fig. 2

LEXICAL ANALYSIS

- BREAKING UP SENTENCE INTO INDIVIDUAL WORDS
- SEARCH FOR EACH WORD OUTSIDE THE CONTEXT OF THE SENTENCE, ALL PARTS OF SPEECH, WORD SENSES AS EACH PART OF SPEECH, AND LEXICAL ASSOCIATIONS WITHIN THE LEXICON
- IF A WORD NOT FOUND, ALLOW CORRECTION AS MISSPELLING OR INTRODUCE LEXICON ENTRY
- MISSING LEXICON ENTRIES UNRESOLVED, OR USER CHOOSES TO HAVE SYSTEM IGNORE SENTENCE

Fig. 3

LEXICAL ANALYSIS DATA

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**COMPUTER (SENSE) 1): A MACHINE FOR PERFORMING CALCULATIONS
AUTOMATICALLY (NOUN)**

**COMPUTER, DATA_PROCESSOR, ELECTRONIC_COMPUTER,
INFORMATION_PROCESSING_SYSTEM**

DEFINITION: A MACHINE FOR PERFORMING CALCULATIONS AUTOMATICALLY

IS KIND OF:

MACHINE (NOUN), ANY MECHANICAL OR ELECTRICAL DEVICE THAT
TRANSMITS OR MODIFIES ENERGY TO PERFORM OR ASSIST IN THE
PERFORMANCE OF HUMAN TASKS, A KIND OF
DEVICE (NOUN), AN INSTRUMENTALITY INVENTED FOR A PARTICULAR
PURPOSE, A KIND OF
INSTRUMENTALITY, **INSTRUMENTATION (NOUN)**, AN ARTIFACT OR SYSTEM
OF ARTIFACTS INSTRUMENTAL IN ACCOMPLISHING SOME END, A KIND OF
ARTIFACT, **ARTEFACT (NOUN)**, A MAN-MADE OBJECT, A KIND OF
OBJECT, **PHYSICAL_OBJECT (NOUN)**, A PHYSICAL (TANGIBLE AND VISIBLE)
ENTITY, A KIND OF
ENTITY, **SOMETHING (NOUN)**, ANYTHING HAVING EXISTENCE, LIVING OR
NON-LIVING

HAS KIND:

HOST, SERVER (NOUN)
PARI-MUTEL _MACHINE, TOTALISATOR, TOTALISER, TOTALIZATOR, TOTALIZER,
(NOUN)
NUMBER_CRUNCHER (NOUN)
CLIENT, GUEST, NODE (NOUN)
DIGITAL_COMPUTER (NOUN)
ANALOG_COMPUTER, ANALOGUE_COMPUTER (NOUN)

HAS PART:

MONITOR (NOUN)
KEYBOARD (NOUN)
COMPUTER_HARDWARE, HARDWARE (NOUN)
DISKETTE, FLOPPY_DISK (NOUN)
DISK_CACHE (NOUN)
DATA_CONVERTER (NOUN)
COMPUTER_CIRCUIT (NOUN)
COMPUTER_ACCESSORY (NOUN)
CHIP, MICRO_CHIP, MICROCHIP. SILICON_CHIP (NOUN)
C.P.U., CENTRAL_PROCESSING_UNIT, CENTRAL_PROCESSOR, CPU, MAINFRAME,
PROCESSOR (NOUN)
CATHODE-RAY TUBE, CRT (NOUN)
BUS, BUSBAR (NOUN)

Fig. 4

LEXICAL ANALYSIS DATA

AS NOUN:

BLANKET, COVER (SENSE 1): BEDDING THAT KEEPS A PERSON WARM IN BED

BLANKET, MANTLE (SENSE 2): ANYTHING THAT COVERS

BLANKET (SENSE 3): A LAYER OF LEAD SURROUNDING THE HIGHLY REACTIVE CORE OF A NUCLEAR REACTOR

AS ADJECTIVE:

ACROSS-THE-BOARD, ALL-EMBRACING, ALL-ENCOMPASSING, ALL-INCLUSIVE, BLANKET, BROAD, ENCOMPASSING, PANOPTIC, WIDE (SENSE 1): BROAD IN SCOPE OR CONTENT

AS VERB:

BLANKET (SENSE 1): COVER AS IF WITH A BLANKET; AS OF SNOW

IS ONE WAY TO:

COVER PROVIDE WITH A COVERING OR CAUSE TO BE COVERED

BLANKET (SENSE 2): FORM A BLANKET-LIKE COVER OVER SOMETHING

IS ONE WAY TO:

TOUCH, ADJOIN, MEET: BE IN CONTACT WITH

Fig. 5

LEXICAL ANALYSIS DATA

GO, GO AWAY, DEPART (SENSE 3): MOVE AWAY FROM A PLACE INTO ANOTHER DIRECTION

OPPOSITE OF:

COME, COME UP: MOVE TOWARD, TRAVEL TOWARD OR APPROACH SOMETHING OR SOMEBODY

PROCEED, GO (SENSE 8): FOLLOW A CERTAIN COURSE

WHICH IS ONE WAY TO:

HAPPEN, HAP, GO ON, PASS OFF, OCCUR, PASS, COME ABOUT, TAKE PLACE: COME TO PASS, OCCUR

FAIL, GO GIVE WAY, DIE, GIVE OUT, CONK OUT, BREAK, BREAK DOWN (SENSE 30): STOP OPERATING OR FUNCTIONING

ONE WAY TO DO SO BEING:

MALFUNCTION, MISFUNCTION: FAIL TO FUNCTION OR FUNCTION IMPROPERLY

ONE WAY TO DO SO BEING:

JAM: GET STUCK OR IMMOBILIZED

SURVIVE, LAST LIVE, LIVE ON, GO, ENDURE, HOLD UP, HOLD OUT (SENSE 15): CONTINUE TO LIVE, ENDURE OR LAST

WHICH ENTAILS:

BE, LIVE: HAVE LIFE, BE ALIVE

Fig. 6

LEXICAL ANALYSIS DATA

S:	AS SUBJECT
ENTITY1	AN ENTITY
t* +	IN INSTANTANEOUS TRANSITION AT THE PRESENT TIME
DO	PERFORMING AN ACTION
O:	AS OBJECT
ENTITY2	A SECOND ENTITY
— C —>	CAUSES
S:	AS SUBJECT
ENTITY2	THE SECOND ENTITY
t* +	IN INSTANTANEOUS TRANSITION AT THE PRESENT TIME
PTRANS	PERFORMING PHYSICAL MOTION
O:	AS OBJECT
ENTITY2	UPON ITSELF
D:	AS DIRECTION
PLACE1	ONE PLACE
—> PLACE2	TO ANOTHER PLACE

Fig. 7

STRUCTURAL ANALYSIS

PHRASE EXTRACTION

- EXTRACT NUMERALS, ADVERBS, DATES AND TIMES FROM SENTENCE
- DETERMINE SENTENCE TYPE
- DEDUCE, BY CONTEXT, THE FEWEST NUMBER OF PERMUTATIONS OF WORD SENSES RESULTING IN REASONABLE MEANINGS OR UNDERSTANDINGS OF THE SENTENCE, BY PROCESSING THE LEXICAL DATA THROUGH 4 STAGES OF TRANSFORMATIONAL GRAMMER RULES

POS-SPECIFIC
PHRASE
STRUCTURE
RULES

POS-SPECIFIC
TRANSFORMATIONAL
RULES

CONCEPT-
SPECIFIC
TRANSFORMA-
TIONAL RULES

CONCEPT-
SPECIFIC
PHRASE
STRUCTURE
RULES

CONCEPTUAL DEPENDENCY

- CONSTRUCT CONCEPTUAL DEPENDENCY REPRESENTATION, PROPOSITIONS, PROPOSITIONAL LINKAGES, PERIPHERAL DATA AND SUBORDINATE CONJUNCTION LINKAGES FROM GRAMMAR RULES APPLIED FOR SENTENCE MEANING INTENDED BY THE USER
- ANY SYNTHETIC AMBIGUITIES UNRESOLVED, OR USER CHOOSES TO HAVE SYSTEM IGNORE SENTENCE

Fig. 8

SENTENCE TYPE DATA

	SENTENCE TYPE	EXAMPLE SENTENCE
1	SVO	JOHN LOVES MARY
2	DOES SVO?	DOES JOHN LOVE MARY?
3	WHAT KIND OF SVO?	WHAT KIND OF SCREW FITS INTO THE BOLT?
4	WHAT KIND OF O DOES SV?	WHAT KIND OF MAN WOULD LISA LIKE TO MEET?
5	HOW MUCH SVO?	HOW MUCH FLOUR FILLS THE ORDER?
6	HOW MUCH O DOES SV?	HOW MUCH MONEY DOES BOB OWE?
7	WHAT SVO?	WHAT FOOL DID THIS?
8	WHAT O DOES SV?	WHAT PURPOSE DOES THIS INSTRUMENT HAVE?
9	WHO VO?	WHO LOVES MARY?
10	WHO DOES SV?	WHO DOES JOHN LOVE?
11	HOW DOES SVO?	HOW DOES JOHN FIT THE BILL?
12	WHEN DOES SVO?	WHEN CAN MARY TRAVEL TO BRAZIL?
13	WHY DOES SVO?	WHY DID JOHN DRIVE TO CINCINNATI?
14	WHERE DOES SVO?	WHERE WOULD ONE FIND THE RESTROOM?
15	HOW MUCH DOES SVO?	HOW MUCH DOES JOHN OWE THE STORE?

Fig. 9A

POS-SPECIFIC FRAGMENT ANALYSIS

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POSSIBLE POS PERMUTATION	MEANING
MILITARY (NOUN) DEMANDS (VERB) CHANGE (NOUN)	THE MILITARY ITSELF DEMANDS CHANGE
MILITARY (ADJECTIVE) DEMANDS (NOUN) CHANGE (VERB)	THE DEMANDS OF THE MILITARY CHANGE

Fig. 9B

POS-SPECIFIC TRANSFORMATIONAL ANALYSIS

180

POS PERMUTATION	WORD SEQUENCE TO WHICH RULE IS APPLIED	RESULTING WORD SEQUENCE
NOUN/VERB/ADJECTIVE/NOUN → NOUN/VERB	THOMAS DECLINED DINNER INVITATION → THOMAS DECLINED	THOMAS DECLINED BECAUSE BILL HAD COLD
NOUN/VERB/NOUN → NOUN/VERB	BILL HAD COLD → BILL HAD	THOMAS DECLINED BECAUSE BILL HAD
NOUN/VERB/CONJ./NOUN/VERB → NOUN/VERB	THOMAS DECLINED BECAUSE BILL HAD → BILL HAD	BILL HAD

Fig. 9C

CONCEPTUAL DEPENDENCY REPRESENTATION:

SUBJECT: "SUPERVISOR"

< * T (PAST TIME, INSTANTANEOUS, TRANSITIONAL) *MTRANS* (TRANSFER OF MENTAL INFORMATION)

RECIPIENT: "SUPERVISOR" → "MARY"

—CAUSE →

SUBJECT: "MARY"

- * T/(INDETERMINATE TIME, INSTANTANEOUS, TRANSITIONAL, NEGATIVE) *MAKE*

OBJECT: "LETTERS"

DIRECTION/LOCATION: "OFFICE"

RECIPIENT: "MARY" → "BOARD"

INSTRUMENT: "TYPEWRITER"

SUBJECT: <EMPTY>

- P TS (INDETERMINATE TIME, POSSIBILITY, TRANSITIONAL START) *DO*

OBJECT: "ANALYSIS"

—CAUSE →

SUBJECT: "ANALYSIS"

- P TF (INDETERMINATE TIME, POSSIBILITY, TRANSITIONAL FINAL) *STATE*

QUALITY: "COMPLETE"

GENERIC PRIMITIVE *BE*:

SUBJECT: "LETTERS"

+ K D (PRESENT TIME, CONTINUAL, TIMELESS) *BE*

QUALITY: "PROPOSAL" (ADJECTIVAL NOUN MODIFYING "LETTERS")

GENERIC PRIMITIVE *PARTOF*:

SUBJECT: "DIRECTORS"

+ K D (PRESENT TIME, CONTINUAL, TIMELESS) *PARTOF* OBJECT: "BOARD"

Fig. 10

CONCEPTUAL DEPENDENCY REPRESENTATION

GENERIC PRIMITIVE BE:

SUBJECT: "ANALYSIS"

+KD (PRESENT TIME, CONTINUAL, TIMELESS) BE

QUALITY: "MARKET" (ADJECTIVAL NOUN MODIFYING "ANALYSIS")

PROPOSITIONS:

1. SUPERVISOR DIRECT MARY
2. MARY TYPE LETTERS
3. MARY TYPE FOR BOARD
4. <NULL SUBJECT> COMPLETE ANALYSIS
5. LETTERS BE PROPOSAL (ADJ. MODIFYING "LETTERS")
6. BOARD COMPRISE DIRECTORS
7. ANALYSIS BE MARKET (ADJ. MODIFYING "ANALYSIS")

PROPOSITIONAL LINKAGES:

- | | | |
|----|-------|---|
| 1. | 1 | {SUPERVISOR DIRECT MARY} |
| 2. | 2 + 3 | {MARY TYPE LETTERS} + {MARY TYPE FOR BOARD} |
| 3. | 4 | {<NULL SUBJECT> COMPLETE ANALYSIS} |
| 4. | 5 | {LETTERS BE PROPOSAL} |
| 5. | 6 | {BOARD COMPRISE DIRECTORS} |
| 6. | 7 | {ANALYSIS BE MARKET} |

PERIPHERAL

1. "3", QUANTITY OF OBJECTIVE NOUN "LETTERS" IN PROPOSITON 2 IN LINKAGE 2
- 2.. "ON 1/15/2001", DATE OF EVENT IN PROPOSITON 3 IN LINKAGE 2

SUBORDINATE CONJUNCTION LINKAGES:

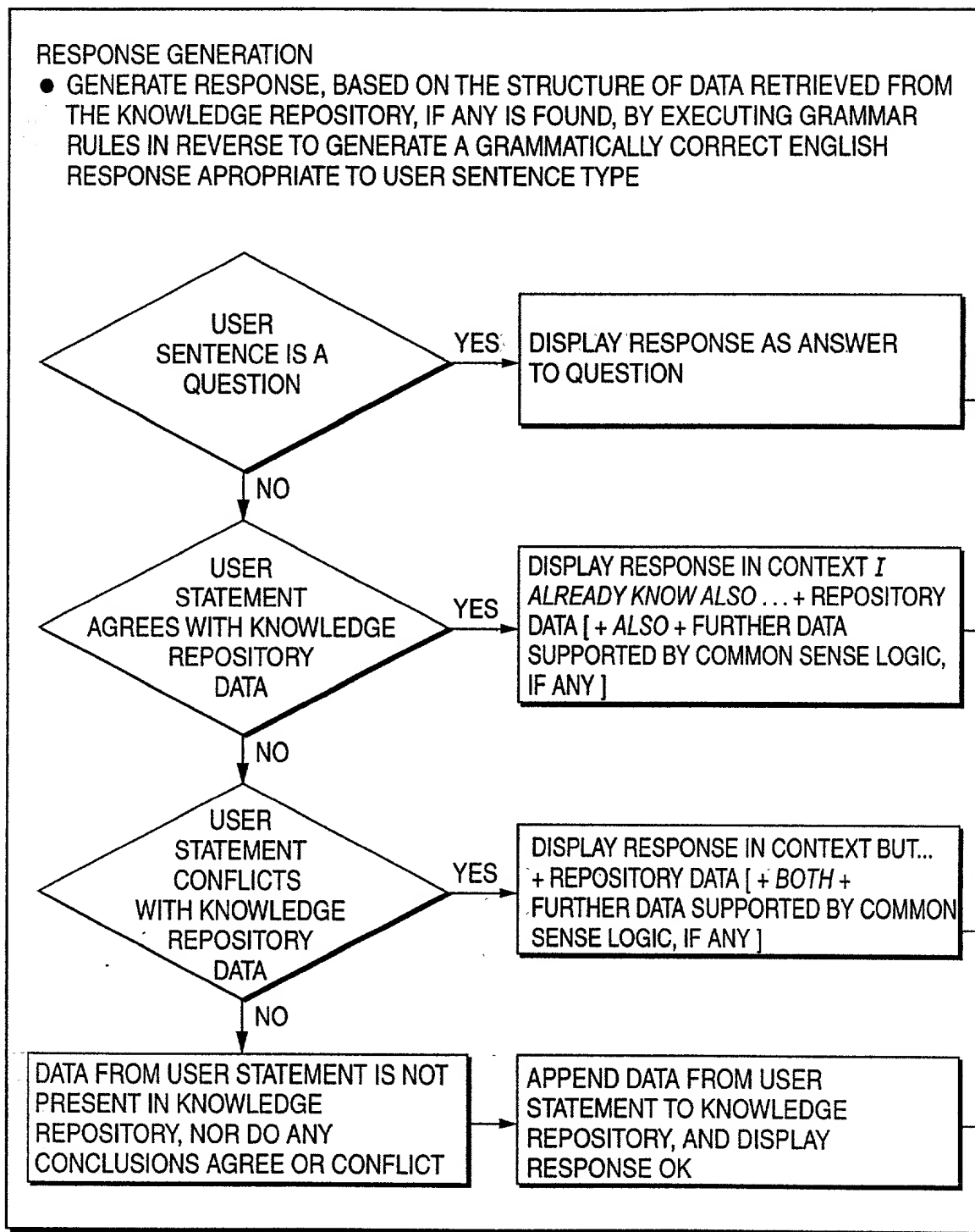
- | | | |
|----|----------|--|
| 1. | 1 THAT 2 | [[SUPERVISOR DIRECT MARY]] THAT [[MARY TYPE LETTERS] +
[MARY TYPE FOR BOARD]] |
| 2. | 2 SO 3 | [[MARY TYPE LETTERS] + [MARY TYPE FOR BOARD]] SO
[[<NULL SUBJECT> COMPLETE ANALYSIS]] |

Fig. 11

DATA MANAGEMENT**"COMMON SENSE" LOGIC**

- APPLY "COMMON SENSE" LOGIC STATEMENTS TO CONCEPTUAL DEPENDENCY REPRESENTATION FOR PRODUCING LOGICAL CONCLUSIONS REGARDING THE USER STATEMENT
- SEARCH KNOWLEDGE REPOSITORY FOR CONCEPTUAL DEPENDENCY REPRESENTATIONS FOR BOTH USER'S STATEMENT AND "COMMON SENSE" LOGICAL CONCLUSIONS
- COMPARE THESE REPRESENTATIONS AGAINST EXISTING ACCUMULATED DATA FOUND IN THE KNOWLEDGE REPOSITORY, IF ANY, FOR IDENTIFYING AGREEMENT OR CONFLICT BETWEEN THEM

Fig. 12

**Fig. 13**